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PTO/SB/05 (4/98)
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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	78-489 (P9415)
First Inventor or Application Identifier	Won-Kyu Suk
Title	Apparatus and Method for Combining...
Express Mail Label No.	EL484185130US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original and a duplicate for fee processing)*
2. [X] Specification [Total Pages 14] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 3]
4. Oath or Declaration [Total Pages 2]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 16 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*
6. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
13. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
15. [ ] Other: .....

16. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
    [ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____
    Prior application information: Examiner _____ *Group / Art Unit:* _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by **reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.**

17. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* or [X] *Correspondence address below*

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Signature	Paul J. Farrell	Date	5/25/00

PATENT
Atty. Docket No. 678-489 (P9415)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner
for Patents
Washington, D.C. 20231

UTILITY APPLICATION FEE TRANSMITTAL

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): Won-Kyu Suk

For: APPARATUS AND METHOD FOR COMBINING SYMBOL DATA IN CDMA COMMUNICATION SYSTEM

Enclosed are:

[X] 10 page(s) of specification

[X] 1 page(s) of Abstract

[X] 3 page(s) of claims

[X] 3 sheets of drawings [X] formal [] informal

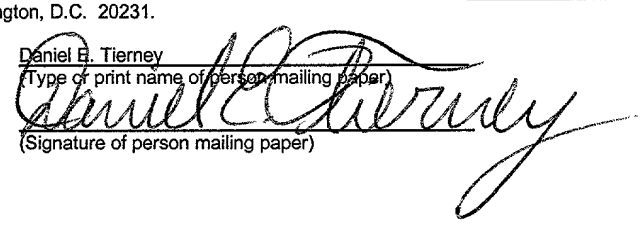
[X] 2 page(s) of Declaration and Power of Attorney

[X] An Assignment of the invention to Samsung Electronics Co., Ltd.

CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date May 25, 2000 in an envelope as "Express Mail Post Office to Addressee" Mail Label Number EL484185130US addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Daniel E. Tierney
(Type or print name of person mailing paper)



(Signature of person mailing paper)

[] This application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:	FILING DATE
__/_____	_____
__/_____	_____

[X] Certified copy of applications

Country	Appln. No.	Filed
Korea	99-18781	May 25, 1999

from which priority under Title 35 United States Code, § 119 is claimed

[] is enclosed.

[X] will follow.

CALCULATION OF UTILITY APPLICATION FEE

For	Number Filed	Number Extra	Rate	Basic Fee $690.00
TOTAL CLAIMS	8	0	x 18 =	$0
INDEPENDENT CLAIMS	5	2	x 78 =	$156.00
[] Multiple Dep. Claim	0		260	$0
				TOTAL$846.00

[] Verified Statement of "Small Entity" Status Under 37 C.F.R. § 1.27. Reduced fees under 37 C.F.R. § 1.9(f) (50% of total) paid herewith $.

*Includes all independent and single dependent claims and all claims referred to in multiple claims. See 37 C.F.R. § 1.75(c).

[X] The amount of $40.00 for recording the attached Assignment is enclosed as a separate check.

[X] Two checks in the amount of $846.00 and $40.00 to cover the [X] recording, [X] filing fee(s) are attached.

[ ] Charge fee to Deposit Account No. 04-1121. Order No. _____
TWO (2) COPIES OF THIS SHEET ARE ENCLOSED.

[X] Please charge any deficiency as well as any other fee(s) which may become due under 37 C.F.R. § 1.16 and 1.17, at any time during the pendency of this application, or credit any overpayment of such fee(s) to Deposit Account No. 04-1121. Also, in the event any extensions of time for responding are required for the pending application(s), please treat this paper as a petition to extend the time as required and charge Deposit Account No. 04-1121 therefor. TWO (2) COPIES OF THIS SHEET ARE ENCLOSED.

Date: May 25, 2000

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APPARATUS AND METHOD FOR COMBINING SYMBOL DATA IN CDMA COMMUNICATION SYSTEM

PRIORITY

This application claims priority to an application entitled "Apparatus and Method for Combining Symbol Data in CDMA Communication System" filed in the Korean Industrial Property Office on May 25, 1999 and assigned Serial No. 99-18781, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an apparatus and method for combining symbol data in a CDMA (Code Division Multiple Access) communication system, and in particular, to an apparatus and method for combining symbol data with a fading component removed.

2. Description of the Related Art

Generally, a base station in a CDMA communication system separates a transmission data signal d(t) into I and Q signals by 1:2 demultiplexing the data signal d(t) into an even-numbered data signal and an odd-numbered data signal. The I and Q signals are multiplied by a corresponding orthogonal code for orthogonal spreading and a pilot signal is added only to the I signal for complex pseudo-noise ("PN") spreading. The resulting signals pass through filters and are upconverted in frequency prior to transmission. A mobile station receiver receives the signal on a fading channel from the

base station. The input signal at the receiver can be expressed as

$$S_I(t) = (PW_0 + IW_d + jQW_d)(PN(I) + PN(Q))$$
$$x\ (cos(wt) + jsin(wt))(f(I) + jf(Q)) \qquad \text{Eq. 1}$$

where $(f(I)+jf(Q))$ is a fading component, P is a pilot signal, W_0 is a pilot channel orthogonal code, W_d is a predetermined orthogonal code for orthogonal modulation and PN(I) and PN(Q) are orthogonal code for orthogonal spreading.

Therefore, the mobile station combines multi-path signals and demodulate symbol data with the highest energy to achieve the best reception. As a result, a decoder can perform accurate decoding. It has been reported that a maximum ratio combining method results in the highest performance. In the maximum ratio combining method, input symbol data is multiplied by a fading component for channel compensation and only symbol data with energies higher than a predetermined level among the channel-compensated symbol data are combined.

The problem with the maximum ratio combining method is that the fading component is entirely canceled when multiplying the symbol data by the fading component only when the phase of received symbol data is equal to the phase of the fading component. Accurate phase compensation to eliminate the fading component has not been achieved in the prior art. Therefore, symbols are combined while the fading component exists. Possible combination of symbols with a deep fading component reduces symbol energy, thereby nullifying the effect of symbol combination to obtain a maximum energy.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an apparatus and

method for combining symbol data with a fading component removed in a mobile station of a CDMA communication system.

It is another object of the present invention to provide an apparatus and method for selecting symbol data of each multi-path to combine symbol data at a maximum ratio in a mobile station of a CDMA communication system.

It is a further object of the present invention is to provide a symbol combining apparatus and method for excluding signals from paths having inverted data owing to serious fading, even though it is determined that any received data has sufficient energy for symbol combination because of a problem of a conventional method in measuring reception energy in a mobile station of a CDMA communication system

The above and other objects can be achieved by providing an apparatus for combining symbols received from multi-paths in a CDMA communication system. In the symbol combining apparatus, a plurality of fingers despread signals received in multi-paths and extract symbol data, and a symbol combiner combines symbol data except for symbol data whose signs are inverted due to fading among the symbol data received from the fingers.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram of a mobile station receiver in a CDMA communication system according to a prior art ; and

FIG. 2 is a block diagram of a combiner shown in FIG. 1 according to an

embodiment of the present invention , for selective combination of symbol data at a maximum ratio.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described hereinbelow with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail.

FIG. 1 is a block diagram of a mobile station receiver that selectively combines symbol data of each multi-path component. Symbol data is combined at a maximum ratio in a CDMA mobile communication system according to a prior art. Each of the fingers for demodulating multi-path components are the same and thus only one of them will be described. It is also to be noted that the following description is conducted on the assumption that four multi-path components are present.

Referring to FIG. 1, mixers 111 and 112 multiply a signal received through an antenna by a carrier cos(wt) and a carrier sin(wt), respectively. Carrier sin(wt) results from shifting the phase of the carrier cos(wt) by 90° for frequency downconversion.

The downconverted signals are

$$S_2(t) = S_1(t) \times (\cos(wt) - j\sin(wt))$$
$$= (PW_0 + IW_d + jQW_d)(PN(I) + jPN(Q))(f(I) + jf(Q))(\cos wt - j\sin wt)$$
$$= (PW_0 + IW_d + jQW_d)(PN(I) + jPN(Q))(f(I) + jf(Q)) \quad \text{Eq. 2}$$

Low pass filters (LPFs) 113 and 114 low-pass filter the output signals of the mixers 111 and 112. A complex PN despreader 115 complex-PN despreads the output signals of the LPFs 113 and 114 with PN codes received from a PN code generator (not shown).

The PN-despread signals are

$$S_3(t) = S_2(t)(PN(I) + jPN(Q))$$
$$= (PW_0 + IW_0 + jQW_d)(PN(I) + jPN(Q))(f(I) + jf(Q))(PN(I) - jPN(Q))$$
$$= (PW_0 + IW_d + jQW_d)(f(I) + jf(Q)) \quad \text{Eq. 3}$$

A pilot signal separator 116 separates an unmodulated pilot signal by multiplying the output signals of the complex PN despreader 115 by a pilot channel orthogonal code W_0. The pilot signal is

$$S_4(t) = S_3(t) \times W_0$$
$$= (PW_0 + IW_d + jQW_d)(f(I) + jf(Q)) \times W_0$$
$$= P(f(I) + jf(Q)) \quad \text{Eq. 4}$$
$$(\text{where } W_d \times W_0 = 0,\ W_0 \times W_0 = 1)$$

Since the pilot signal is +1 in Eq. 4, the pilot signal shown in Eq. 4 is a fading component. That is, P is a pilot signal, in Eq. 4, $PW_0 \times W_0 = -1$; as a result in Eq. 4, the pilot signal is a fading component.

A channel estimator 117 accumulates the pilot signal $S_4(t)$ as expressed as Eq. 4 for a predetermined time and estimates a channel from a base station to the terminal. A complex conjugate generator 118 complex-conjugates the output of the channel

estimator. That is, the complex conjugate generator 118 conjugates the accumulated signal of $S_4(t)$.

Mixers 119 and 120 multiply the output of the complex PN despreader 115 by a predetermined orthogonal code W_d, for orthogonal modulation. A fading component exists in the output signals of the mixers 119 and 120 given by

$$S_5(t) = S_3(t) \times W_d$$
$$= (PW_0 + IW_d + jQW_d)(f(I) + jf(Q)) \times W_d$$
$$= (I + jQ)(f(I) + jf(Q)) \quad \text{Eq. 5}$$

A fading compensator 121 compensates for the fading component by multiplying the outputs of the mixers 119 and 120 by the output of the complex conjugate generator 118. That is, the signal of Eq.5 is multiplied by a signal having a gain resulting from accumulating the fading component of Eq. 4 for a predetermined time to thereby compensate for the fading This can be expressed as

$$S_6(t) = S_5(t) \times [gain]\ (f(I) - jf(Q))$$
$$= (I + jQ)(f(I) + jf(Q)) \times [gain]\ (f(I) - jf(Q))$$
$$= [gain]\ (I + jQ) \quad \text{Eq. 6}$$

The gain in Eq. 6 may be an inverted value due to deep fading. A symbol combiner 122 receives such a signal as shown in Eq. 6 from each finger and combines symbol data except for symbols whose signs are inverted due to deep fading. That is, the symbol combiner 122 excludes symbols including deep fading components from symbol combination to increase symbol energy.

The symbol combiner 122 is shown in detail in FIG. 2. To achieve maximum symbol energy, the symbol combiner 122 is so configured that symbol data whose sign is inverted due to fading among symbol data including multi-path components is excluded from symbol combination although it has symbol energy is higher than a predetermined threshold.

Referring to FIG. 2, energy determiners 211 and 212 calculate the energies of the I and Q channel symbol data multiplied by a fading component and compare the energy with thresholds THI and THQ received from a higher layer controller (not shown). If the symbol data energies are equal or greater than the thresholds, the energy determiners 211 and 212 determine that the symbol data is locked and output the symbol data to effective path selectors 213 and 214. If the symbol data energies are smaller than the thresholds, the energy determiners 211 and 212 set the symbol data to 0s. The symbol data output from the energy determiner 211 is a 2's complement of n bits obtained by subjecting the symbol values ranging from +1 to −1 to ADC (Analog-to-Digital Conversion).

The effective path selectors 213 and 214 compare the MSBs (i.e., sign bits) of the symbol data (2's complements each having n bits) received from the respective energy determiners 211 and 212. The effective path selectors 213, 214 set symbol data with a sign different from the sign of a majority of symbol data to 0s, thus excluding the minority symbol data from symbol combination. The other symbol data having a sign corresponding to the majority of symbol data are output by the effective path selectors. Here, the symbol data with the sign different from the sign of the majority of symbol data is considered to have been inverted due to deep fading.

An I channel combiner 215 and a Q channel combiner 216 accumulate the

symbol data received from the effective path selectors 213 and 214 in symbol units, combine the accumulated symbol data, and output the combined symbol data under the control of a time controller 217. A switch 218 multiplexes the outputs of the I and Q channel combiners 215 and 216 under the control of the time controller 217.

A decimator 219 decimates an input long code. A derandomizer 220 XOR-gates the outputs of the switch 218 and the decimator 219 to de-randomize a signal randomized by a long code at a transmitter. Here, a different long code is assigned to each subscriber as an identification. The de-randomized signal is fed to a decoder (not shown in FIG. 2) by de-randomizer 220.

In the thus-constituted receiver, upon receipt of a signal, the mixers 111 and 112 convert the input signal to baseband signals I and Q by frequency downconversion and the LPFs 113 and 114 low-pass filter the baseband signals. The complex PN despreader 115 PN despread the low pass filtered signals I and Q by multiplying them by PN(I) and PN(Q). The pilot separator 116 separates a pilot signal from the PN despread signals by multiplying the PN despread signals by a pilot channel orthogonal code. The channel estimator 117 accumulates the separated pilot signal for a predetermined time and the complex conjugate generator 118 obtains the complex conjugate of the accumulated signal as a channel compensation signal. Mixers 119 and 120 multiply the PN despread signals by an orthogonal code for a data channel, for channel demodulation. The fading compensator 121 multiplies the demodulated signal by the channel compensation signal received from the complex conjugate generator 118, for channel compensation. The output of the fading compensator 121 is channel-compensated symbol data. The energy determiners 211 and 212 calculate the symbol energies of the symbol data and compare the symbol energies with the thresholds THI and THQ to detect symbol data with energy locked. Energy determiner 211 determines the energy of the I channel symbol data and the energy determiner 212 the energy of the Q channel symbol data. The energy

determiners 211 and 212 simply output symbol data with energy higher than the thresholds to the effective path selectors 213 and 214, and set symbol data with energy smaller than the thresholds to 0s and output the symbol data to the effective path selectors 213 and 214. Hence, symbol data with much energy lost due to fading is excluded from symbol combination. The energy determiners 211 and 212 calculate the symbol energies by integrating signals in symbol units and squaring them. If the energy of symbol data whose sign is inverted due to deep fading is higher than the thresholds, it is considered to be locked. This symbol data should be excluded from symbol combination to achieve maximum symbol energy. Therefore, the effective path selectors 213 and 214 determine the signs of symbols received from the energy determiners 211 and 212, detect symbol data with a sign different from the sign of a majority of symbol data, set the detected symbol data to 0s, and output the symbol data to channel combiners 215 and 216. Consequently, the channel combiners 215 and 216 combine the other symbols except for the symbols of which much energy has been lost due to fading, thereby outputting the symbol data with higher energy to the decoder.

FIG. 3 is a flowchart illustrating a symbol combining procedure in the symbol combiner 122.

Referring to FIG. 3, the symbol combiner 122 receives symbol data from four fingers in step 311 and calculates the energy of each symbol data in step 313. In step 315, the symbol combiner 122 compares the calculated energy with a threshold. If the energy is greater than the threshold, the symbol combiner 122 selects the symbol data with the energy for symbol combination in step 319. If the energy is less than the threshold, the symbol combiner 122 sets the symbol data with the energy to 0 in step 317. In this manner, symbol data having a predetermined energy is extracted. The symbol combiner 122 separates the extracted symbol data into symbol data having a sign corresponding to a majority sign and symbol data having a sign different from the

majority sign by checking the sign bit (MSB) of each symbol data with energy greater than the threshold in step 321. Here, the symbol data with the sign different from the majority sign is set to 0s, thus excluding the minority symbol data from symbol combination in step 325, and the majority symbol data is selected for symbol combination in step 323. The symbol combiner 122 accumulates the majority symbol data selected in step 323, thus combining the symbol data in step 327. That is, the symbol data with the majority sign is combined, excluding the symbol data with a sign which has been inverted due to deep fading from the symbol combination. Consequently, only the symbol data with higher energy is fed to the decoder.

As described above, the present invention excludes symbol data whose sign is inverted due to fading from symbol combination although its energy is locked, that is, its energy is higher than a threshold. Therefore, symbol energy that is passed is increased and an accurate decoding may be performed by subjecting symbol data with locked energy to symbol combination in conventional technology.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. An apparatus for combining symbols received from multi-paths in a CDMA communication system, comprising:

a plurality of fingers each for despreading a signal received in one path and extracting symbol data; and

a symbol combiner for combining symbol data except for symbol data whose signs are inverted due to fading among the symbol data received from the fingers.

2. The apparatus of claim 1, wherein the symbol combiner comprises:

an energy determiner for calculating the energy of symbol data received from the fingers and outputting symbol data with energy higher than a threshold;

an effective path selector for outputting only symbol data with a sign corresponding to the majority sign among the symbol data received from the energy determiner; and

a channel combiner for accumulating the symbol data received from the effective path selector and outputting the accumulated symbol data.

3. The apparatus of claim 1, wherein the symbol data is a 2's complement of n bits.

4. An apparatus for combining symbols received from multi-paths in a CDMA communication system, comprising:

a plurality of fingers each having at least a fading component generator for generating a fading component by extracting a pilot signal from a signal received from a path, a channel demodulator for extracting symbol data by despreading the input signal, and a fading compensator for multiplying the symbol data by the fading component for channel compensation;

an energy determiner for calculating the energy of symbol data received from the fingers and outputting symbol data with energy higher than a threshold;

an effective path selector for outputting only symbol data with a sign corresponding to the majority sign among the symbol data received from the energy determiner; and

a channel combiner for accumulating the symbol data received from the effective path selector and outputting the accumulated symbol data.

5. The apparatus of claim 4, wherein the symbol data is a 2's complement of n bits.

6. An apparatus for combining symbols received from multi-paths in a CDMA communication system, comprising:

a first energy determiner and a second energy determiner for calculating the energy of corresponding I and Q channel symbol data and outputting symbol data with energy higher than a threshold;

a first effective path selector and a second effective path selector for outputting only symbol data with a sign corresponding to the majority sign among the symbol data received from the first and second energy determiners;

an I channel combiner and a Q channel combiner for accumulating the symbol data received from the first and second effective path selectors, respectively, and outputting the accumulated symbol data;

a switch for multiplexing the symbol data received from the I and Q channel combiners; and

a de-randomizer for XOR-gating the symbol data received from the switch and a predetermined long code and outputting the de-randomized symbol data.

7. A method for combining symbols received via multiple paths in a CDMA

communication system, comprising the steps of:

receiving symbol data from a plurality of fingers;

calculating the energy of each received symbol data and comparing the energy with a threshold;

extracting symbol data with energy higher than the threshold as symbol data to be combined;

selecting symbol data having a sign corresponding to the majority sign by checking the signs of the extracted symbol data; and

combining the selected symbol data in symbol units through accumulation.

8. A method for combining symbols received via multiple paths in a CDMA communication system, comprising the steps of:

receiving symbol data from a plurality of fingers by an energy determiner;

calculating the energy of each received symbol data and comparing the energy with a threshold by the energy determiner;

outputting symbol data with energy higher than the threshold to an effective path selector and setting symbol data with energy less than the threshold to 0s by the energy determiner;

checking the signs of the symbol data received from the energy determiner by the effective path selector;

setting symbol data with a sign different from the majority sign of the other symbol data to 0s and outputting the other majority data to a channel combiner by the effective path selector; and

combining the symbol data received from the effective path selector in symbol units through accumulation by the channel combiner.

ABSTRACT OF THE DISCLOSURE

An apparatus and method for combining symbols received from multi-paths in a CDMA communication system. In the symbol combining apparatus, a plurality of fingers despread signals received in multi-paths and extract symbol data, and a symbol combiner combines symbol data except for symbol data whose signs are inverted due to fading among the symbol data received from the fingers.

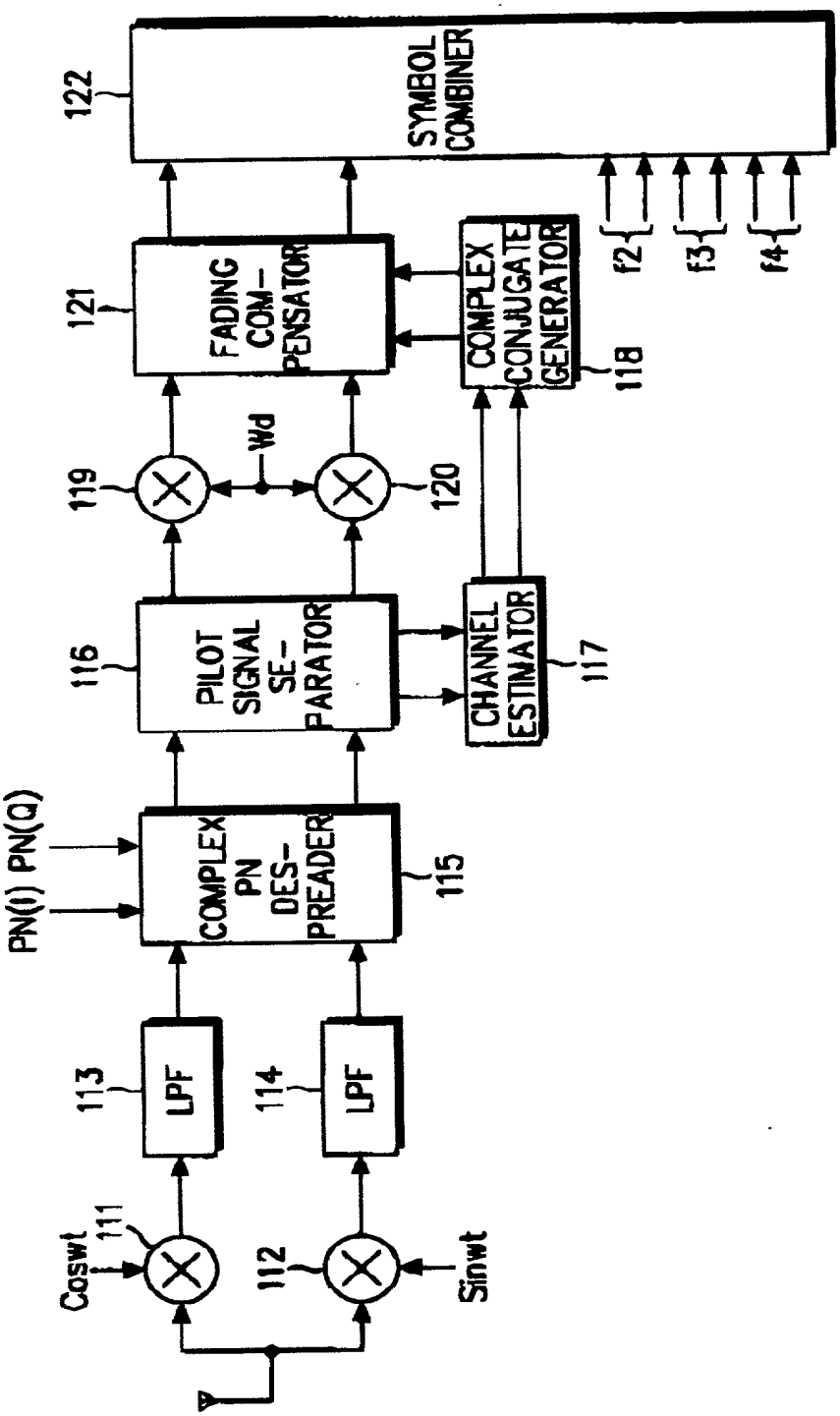
SYMBOL COMBINER
122
FADING COM-PENSATOR
121
COMPLEX CONJUGATE GENERATOR
118
f2
f3
f4
Wd
119
120
PILOT SIGNAL SE-PARATOR
116
CHANNEL ESTIMATOR
117
PN(I) PN(Q)
COMPLEX PN DES-PREADER
115
LPF
113
LPF
114
Coswt
111
112
Sinwt

FIG. 1

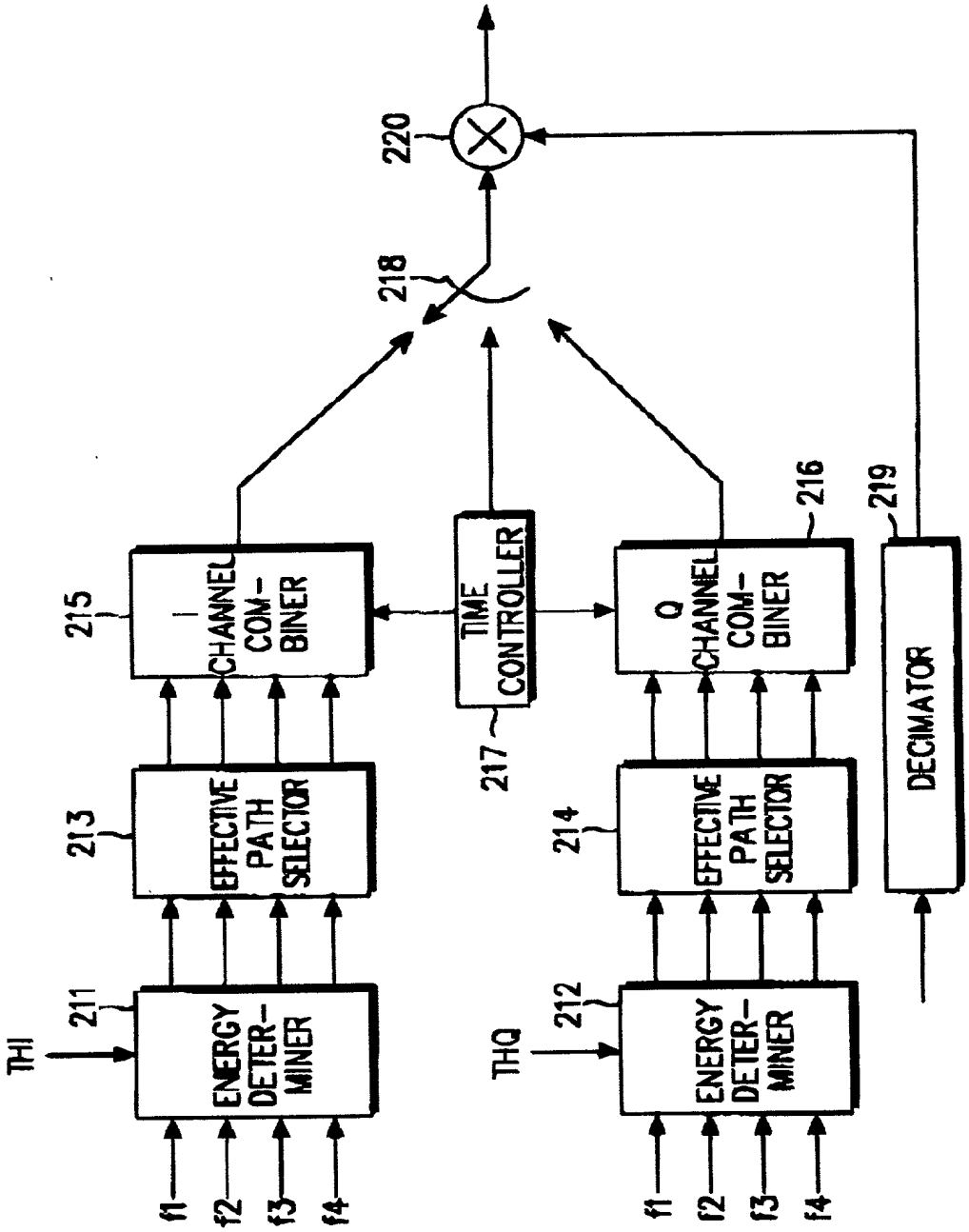
THI
211
ENERGY DETER-MINER
213
EFFECTIVE PATH SELECTOR
215
I CHANNEL COM-BINER
f1
f2
f3
f4
THQ
212
ENERGY DETER-MINER
214
EFFECTIVE PATH SELECTOR
216
Q CHANNEL COM-BINER
217
TIME CONTROLLER
218
220
219
DECIMATOR

FIG. 2

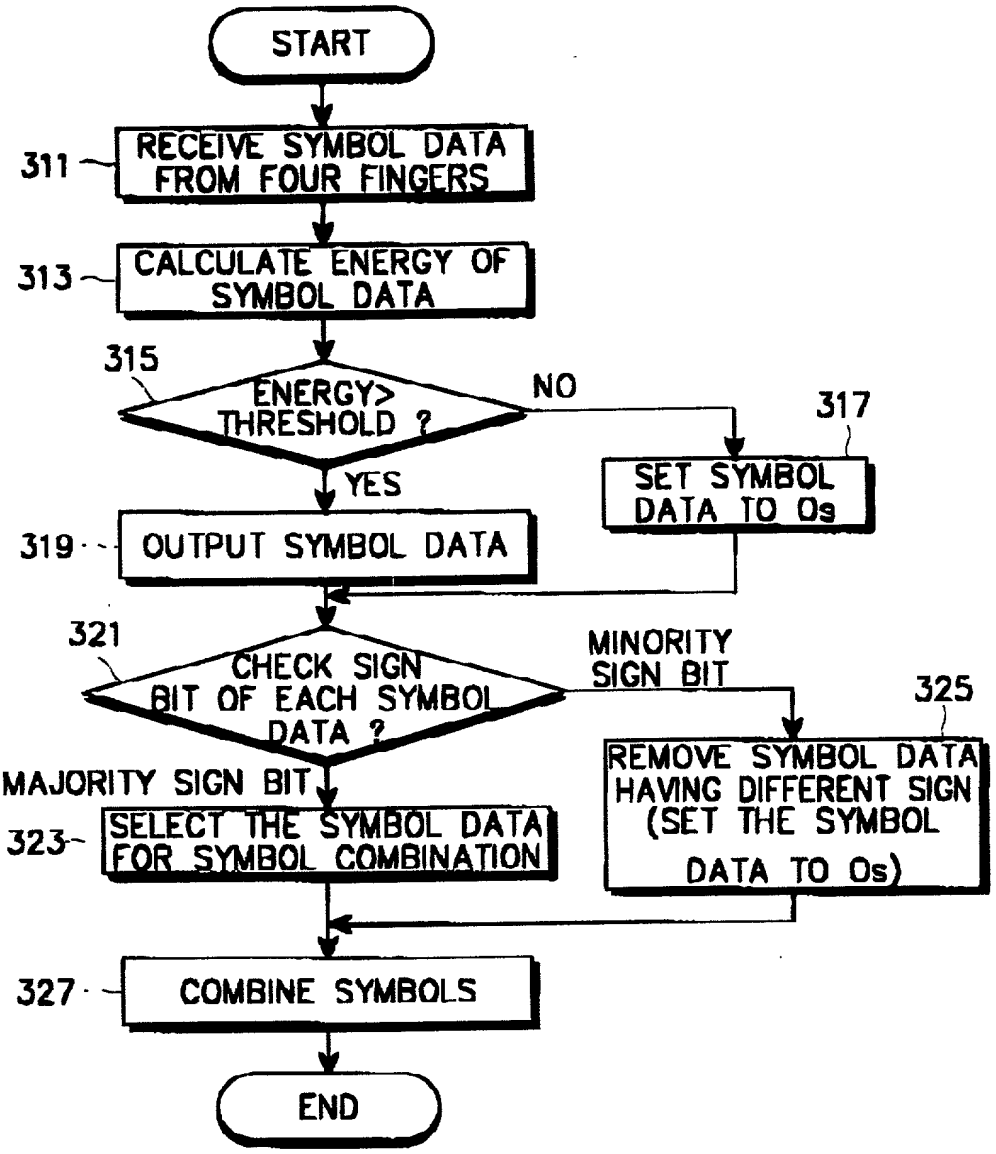
START
311
RECEIVE SYMBOL DATA FROM FOUR FINGERS
313
CALCULATE ENERGY OF SYMBOL DATA
315
ENERGY> THRESHOLD ?
NO
317
SET SYMBOL DATA TO Os
YES
319
OUTPUT SYMBOL DATA
321
CHECK SIGN BIT OF EACH SYMBOL DATA ?
MINORITY SIGN BIT
325
REMOVE SYMBOL DATA HAVING DIFFERENT SIGN (SET THE SYMBOL DATA TO Os)
MAJORITY SIGN BIT
323
SELECT THE SYMBOL DATA FOR SYMBOL COMBINATION
327
COMBINE SYMBOLS
END

FIG. 3

PTO/SB/01 (6/95)

DECLARATION

Docket No 678-489 (P9415)

AS A BELOW NAMED INVENTOR, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe that I am the original, first and sole *(if only one name is listed below)*, or an original, first and joint inventor *(if plural names are listed below)*, of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE: APPARATUS AND METHOD FOR COMBINING SYMBOL DATA IN CDMA COMMUNICATION SYSTEM

the specification of which either is attached hereto or indicates an attorney docket no. 678-489 (P9415), or

[ ] was filed in the U.S. Patent & Trademark Office on _____ and assigned Serial No. _____,

[ ] and *(if applicable)* was amended on _____ _____,

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability and to the examination of this application in accordance with Title 37 of the Code of Federal Regulations §1.56. I hereby claim foreign priority benefits under Title 35, U.S. Code §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States, or §119(e) of any United States provisional application(s), listed below and have also identified below any foreign applications for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

			Priority Claimed:
1999-18781	Korea	25/05/1999	Yes [X] No [ ]
(Application Number)	*(Country)*	*(Day/Month/Year filed)*	
_____	_____	_____	Yes [ ] No [ ]
(Application Number)	*(Country)*	*(Day/Month/Year filed)*	

I hereby claim the benefit under Title 35, U.S. Code, §120, of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application(s) in the manner provided by the first paragraph of Title 35, U.S. Code, §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, The Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial Number)	*(Filing Date)*	*(STATUS: patented, pending, abandoned)*
(Application Serial Number)	*(Filing Date)*	*(STATUS: patented, pending, abandoned)*

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I HEREBY DECLARE that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 U.S. Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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